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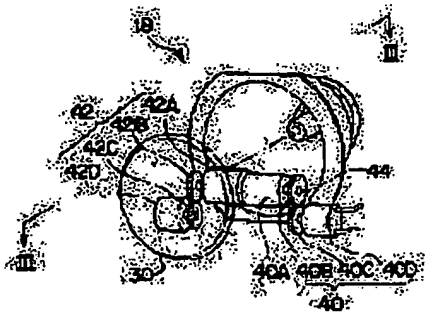
(54) HEAD LAMP DEVICE FOR VEHICLE

(57)Abstract:

PURPOSE: To improve the visibility in front of a vehicle without giving the glare to other vehicles.

CONSTITUTION: Cam-shaped shielding cams 40A, 42A continuously changed with the distance from a rotary shaft 44 to the outer periphery along the peripheral direction are provided in a head lamp 18. The shielding cams 40A, 42A are driven by motors 40D, 42D and individually rotated. The cut line on the right side in the vehicle width direction within cut lines appearing in front of a vehicle is vertically changed in position as the shielding cam 42A is rotated, and the cut line on the left side in the vehicle width direction is vertically changed in position as the shielding cam 42A is rotated. A control device not shown in the figure detects the position of another vehicle based on the image obtained when the front of the vehicle is picked up and controls the rotation of the shielding cam corresponding to the position of the other vehicle not to give the glare to the other vehicle.



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CLAIMS

[Claim(s)]
[Claim 1] the object for vehicles characterized by providing the following -- a headlight -- equipment A change means to make the position of the boundary of the portion by which the light from a head lamp is irradiated in the field ahead of vehicles which are respectively different along the vehicles cross direction by preparing more than one in a head lamp, and changing the irradiation range or the direction of radiation of light respectively, and the portion which is not irradiated change A detection means to detect the position of the other car, and control means which control the change means corresponding to the position of the aforementioned other car not to give a glare to the aforementioned other car based on the position of the other car detected by the aforementioned detection means

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[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention -- the object for vehicles -- a headlight -- the vehicles which control the luminous intensity distribution of the head lamp which starts equipment and irradiates the front of vehicles during a vehicles run especially -- a headlight -- it is related with equipment
[0002]
[Description of the Prior Art] Couple arrangement of the head lamp is carried out at vehicles right-hand side and on the left-hand side of the vehicles front end section, when it is difficult to check a front situation by looking like night, the light is switched on, and the front visibility of a driver is raised. When this head lamp has the common composition which the irradiation range can change only to two stages of a high beam and a low beam and the other cars, such as precedence vehicles and opposite vehicles, exist, a low beam is chosen in many cases so that the unpleasant glare which makes the driver of the other car dazzle may not be given. however -- cases, like the distance between two cars with precedence vehicles is long, for example -- a low beam -- a driver -- irradiation of a head lamp -- continuing and viewing dark space out of range, by the high beam, always irradiating the suitable range of front had the problem of being difficult, like giving a glare to precedence vehicles etc.
[0003] For this reason, the gobo for shading irradiation light is prepared in the interior of a head lamp, without giving a glare to the other car, the aforementioned gobo is moved so that sufficient irradiation range may be acquired, and controlling the position of the boundary (this boundary is hereafter called cutline) of an irradiation field and a non-irradiated field is proposed. moreover, it considers as the technology which controls the position of a cutline so that a glare may not be given to the other car, the situation ahead of vehicles is picturized by the CCD camera etc., precedence vehicles are recognized based on the picture signal outputted from a CCD camera, the distance between two cars with precedence vehicles is detected, and controlling the luminous intensity distribution of a head lamp according to the distance between two cars is proposed (refer to Provisional-Publication-No. 62 No. - 131837 official report)
[0004]
[Problem(s) to be Solved by the Invention] However, control of the position of the cutline by the gobo is performed to the whole cutline which continues along the vehicles cross direction. For this reason, since it was controlled to move to the position where precedence vehicles do not exist or a cutline does not give a glare to opposite vehicles in cases, like the distance between two cars with precedence vehicles is large when opposite vehicles approached, for example, shortage of the irradiation range arose without light fully being irradiated by the lane self-vehicles run, and there was a problem that the visibility of a driver fell.
[0005] the object for vehicles which can raise the visibility ahead of vehicles, without having accomplished this invention in consideration of the above-mentioned fact, and giving a glare to the other car -- a headlight -- it is the purpose to obtain equipment
[0006]

[Means for Solving the Problem] the object for vehicles which starts this invention in order to attain the above-mentioned purpose -- a headlight -- equipment By preparing more than one in a head lamp, and changing the irradiation range or the direction of radiation of light respectively A change means to make the position of the boundary of the portion by which the light from a head lamp is irradiated in the field ahead of respectively different vehicles along the vehicles cross direction, and the portion which is not irradiated change, It has the control means which control the change means corresponding to the position of the aforementioned other car so that a glare may not be given to the aforementioned other car based on the position of the other car detected by detection means to detect the position of the other car, and the aforementioned detection means.

[0007]

[Function] In this invention, two or more change meanses to make the position of the boundary of the portion by which the light from a head lamp is irradiated in the field ahead of respectively different vehicles along the vehicles cross direction, and the portion which is not irradiated change are prepared in the head lamp by changing the irradiation range or the direction of radiation of light respectively. By this, when the irradiation range or the direction of radiation of light is made to change by any one change means in two or more change meanses, the position of the boundary of the portion in the predetermined field corresponding to this change means by which light is irradiated, and the portion which is not irradiated, i.e., the position of a cutline, will be changed. Moreover, this invention detects the position of the other car and controls the change means corresponding to the position of the aforementioned other car based on the position of the detected other car not to give a glare to the aforementioned other car. Thus, since the change means corresponding to the position of the other car is controlled, when the other car is detected, it is controlled so that only the position of the cutline in the field where the detected other car exists does not give a glare.

[0008] For this reason, precedence vehicles do not exist or, also for example, in opposite vehicles having approached in the situation that the distance between two cars with precedence vehicles is large etc. While falling so that only the position of the cutline in the predetermined field where opposite vehicles exist may not give a glare to opposite vehicles, and giving a glare to the aforementioned opposite vehicles is prevented Since the position of the cutline of the portion which separated from the aforementioned field, for example, the cutline in the field corresponding to the lane self-vehicles run, does not fall, shortage of the irradiation range arises and the visibility of a driver does not fall. Thus, since it is controlled so that only the position of the cutline corresponding to the position of the other car does not give a glare when the other car is detected, the visibility ahead of vehicles can be raised, without giving a glare to the other car.

[0009]

[Example] Hereafter, with reference to a drawing, the example of this invention is explained in detail. as shown in drawing 1 , the engine hood 12 arranges in the upper surface section of front body 10A of vehicles 10 -- having -- **** -- the front end section of front body 10A -- the vehicles cross direction -- once -- since -- the other end is covered and the front bumper 16 is being fixed The head lamps 18 and 20 of a couple are arranged in vehicles cross direction both ends between this front bumper 16 and the first transition section of the engine hood 12.

[0010] Windshield glass 14 is formed near the back end section of the engine hood 12, and the room mirror 15 is formed in it near the part corresponding to the upper part side of the windshield glass 14 of the vehicles 10 interior. TV camera 22 for picturizing the situation ahead of vehicles near the room mirror 15 is arranged. TV camera 22 is connected to the image processing system 48 (refer to drawing 4). The TV camera which outputs the picture signal which is equipped with the CCD element which detects only the quantity of light as TV camera 22, and expresses monochrome picture with this example is used.

[0011] In addition, as for the arrangement position of TV camera 22, it is desirable to be arranged in the position near [as possible] the view position (the so-called eye point) of a driver so that the passage configuration ahead of vehicles can be recognized correctly and it may agree by visual feeling of a driver. Moreover, the passage configuration corresponding to one lane formed with a configuration, for

example, the center line, a curbstone, etc. of an advance way is included in the passage configuration in this example.

[0012] Moreover, the speedometer which is not illustrated is arranged by vehicles 10 and the vehicle speed sensor 66 (refer to drawing 4) which detects the vehicle speed V of vehicles 10 is attached in the cable of this speedometer that is not illustrated. It connects with the image processing system 48, and this vehicle speed sensor 66 outputs the detection result of the vehicle speed V.

[0013] As shown in drawing 2 and drawing 3 , a head lamp 18 is a projector type head lamp, and is equipped with the convex lens 30, the bulb 32, and the lamp house 34. The lamp house 34 is being fixed to the frame which vehicles 10 do not illustrate by the abbreviation horizontal, and a convex lens 30 is fixed to one opening of a lamp house 34, and the bulb 32 is being fixed to opening of another side through the socket 36 so that the point emitting light may be located on the optical axis L of a convex lens 30 (medial axis of a convex lens 30).

[0014] The reflector 38 of an ellipse reflector is formed in the bulb side of the lamp house 34 interior, it is reflected by the reflector 38 and the light injected from the bulb 38 is condensed between a convex lens 30 and a bulb 32. Actuators 40 and 42 are arranged in this condensing neighborhood of a point. The actuator 40 equips the axis of rotation 44 fixed so that it might meet crosswise [vehicles] in a lamp house 34 with shading cam 40A supported to revolve possible [rotation], and gearing 40B has fixed to this shading cam 40A. In gearing 40B, gearing 40C which fixed to the driving shaft of motor 40D has geared. Motor 40D is connected to the driver 64 of a control unit 50.

[0015] moreover, it comes out with shading cam 42A supported to revolve by the aforementioned axis of rotation 44 possible [rotation], gearing 40B which fixed to shading cam 40A, motor 42D, and gearing 40C which fixes to a driving shaft at motor 42D, and gears with gearing 40B, and the actuator 42 as well as an actuator 40 is constituted Motor 40D is also connected to the driver 64 of a control unit 50. The light of the bulb 32 by which reflective condensing was carried out by the reflector 38 is shaded by the shading cams 40A and 42A of actuators 40 and 42, and the other light is injected from a convex lens 30.

[0016] The distance from the axis of rotation 44 to a periphery is carrying out the cam configuration which changes continuously along with a circumferencial direction, and the aforementioned shading cams 40A and 42A rotate it separately respectively, when Motors 40D and 42D drive according to the signal from a control unit 50. The position of the boundary where the light of a bulb 32 is divided by passage light and the shaded light changes up and down with rotation of these shading cams 40A and 42A. It will appear as a cutline this boundary of whose is a boundary of the light and darkness in the luminous intensity distribution ahead of vehicles 10.

[0017] As shown in drawing 7 , the aforementioned boundary formed of shading cam 40A When it appears as a cutline 70 on the right-hand side of [in the irradiation field by the head lamp 18] the vehicles cross direction and shading cam 40A rotates, the position of a cutline 70 It moves to parallel from the position (the position shown in drawing 7 as a solid line as a cutline 70, position below the so-called high beam) corresponding to the most significant to the position (the position shown in drawing 7 with a fictitious outline, position of the so-called low beam average) corresponding to the least significant.

[0018] Moreover, the aforementioned boundary formed of shading cam 42A appears as a cutline 72 on the left-hand side of [in an irradiation field] the vehicles cross direction, and when shading cam 42A rotates, the position of a cutline 72 moves to parallel from the position (the position shown in drawing 7 as a solid line as a cutline 72, position below the so-called high beam) of the most significant to the position (the position shown in drawing 7 with a fictitious outline, position of the so-called low-beam average) of the least significant.

[0019] Moreover, since a head lamp 20 is the same composition as a head lamp 18, although detailed explanation is omitted, as shown in drawing 4 , actuators 41 and 43 are attached, and the position of the cutline on the left-hand side of an irradiation field and the position of a right-hand side cutline are respectively moved separately with the operation of actuators 41 and 43.

[0020] As shown in drawing 4 , the control unit 50 is constituted including the buses 62 which connect a

read-only memory (ROM) 52, RAM (RAM) 54, a central processing unit (CPU) 56, input port 58, an output port 60, and these, such as a data bus and a control bus. In addition, the map and control program which are mentioned later are memorized by this ROM52.

[0021] The vehicle speed sensor 66 and the image processing system 48 are connected to input port 58. This image processing system 48 carries out the image processing of the image picturized by TV camera 22 based on the signal inputted from TV camera 22 and a control unit 50 so that it may mention later. The output port 60 is connected to the actuators 40 and 42 of a head lamp 18, and the actuators 41 and 43 of a head lamp 20 through the driver 64. Moreover, the output port 60 is connected also to the image processing system 48.

[0022] Next, an operation of this example is explained with reference to the flow chart of drawing 5 and drawing 6 . If a driver turns on the light switch which vehicles 10 do not illustrate and head lamps 18 and 20 are made to turn on, the control main routine shown in drawing 5 for every predetermined time will be performed. At Step 200 of this control main routine, other car recognition processing is performed and the opposite vehicles which are running the precedence vehicles precede with self-vehicles and it is running, and the lane which counters are recognized. This other car recognition processing is explained with reference to the flow chart of drawing 6 .

[0023] When vehicles 10 are running the road 122, an example (image 120) of the image which carried out abbreviation coincidence with the picture checked by looking by the driver picturized by TV camera 22 is shown in drawing 8 (A). This road 122 equips with the white line 124 the both sides of the lane vehicles 10 run. In addition, a position is pinpointed by the coordinate (Xn and Yn) of the system of coordinates which become settled by the X-axis by which each pixel on the above-mentioned image was set up on the image, and which intersects perpendicularly respectively, and the Y-axis. Below, recognition of the other car is performed based on this image.

[0024] At Step 400, the field which has the predetermined width of face gamma on an image as shown in drawing 9 is set up as a white line detection window field Wsd. In this example, the white line of the position which crosses 60m of front of vehicles 10 in consideration of only the picture to the abbreviation 40-50m ahead of vehicles 10 being undetectable at the time of a night run of vehicles 10 is not detected. Moreover, the field of the lower part in a picture has the low accuracy in which the other car exists. For this reason, the white line detection window field Wsd which removed the downward field from a 140 or more-horizontal line predetermined field and the predetermined minimum line 130 is set up so that the white line detection window field Wsd can be detected even for 60m even of front of vehicles 10.

[0025] At the following step 402, the inside of the window field Wsd is differentiated about brightness, and the peak point (the maximum point) of this differential value is extracted as an edge point which is a white line candidate point. That is, the inside of the window field Wsd is differentiated [pixel / each / horizontal perpendicularly (the direction of drawing 9 arrow A)] about the brightness from the pixel of the lowest position to the pixel of the best position, and change of a luminosity extracts the peak point of a big differential value as an edge point. The edge point which continues by this like the dashed line 132 shown in the window field Wsd of drawing 9 as an example is extracted.

[0026] Straight-line approximation processing is performed at Step 404. This processing carries out straight-line approximation of the edge point extracted by white line candidate point sampling processing using the Hough (Hough) conversion, and asks for the approximation straight lines 142 and 144 which met the line presumed to be a white line. intersection PN which asked for and asked for the intersection PN of the approximation straight line for which it asked (X coordinate value =XN) at the following step 405 a horizontal variation rate with the intersection P0 (X coordinate value =X0) of the approximation straight line in the case of the straight-line way which is made into criteria and which was appointed beforehand -- an amount A (A=XN-X0) is calculated This amount A of displacement corresponds to the degree of the curve of a road 122.

[0027] At the following step 406, the amount A of displacement is A2 >=A>=A1. A road 122 judges whether it is an abbreviation straight-line way by judging whether it is within the limits. This criterion value A1 It is a reference value showing the boundary of a straight-line way and a right curve way, and

is the criterion value A2. It is a reference value showing the boundary of a straight-line way and a left curve way. When judged with a straight-line way at Step 406, the vehicle speed V of the self-vehicles 10 is read at Step 408.

[0028] Vehicles recognition field WP which recognizes precedence vehicles and opposite vehicles at the following step 410 according to the read vehicle speed V It is in charge of setting up and they are amendment amendment width-of-face alphaL and alphaR about the position of an approximation straight line. It determines. At the time of a high-speed run, even if the direct front of vehicles is a road near an abbreviation straight line since the radius of curvature which can circle is small at the time of a low-speed run, although it can consider that it is running the road of an abbreviation straight line, since the radius of curvature of the road in which vehicles can circle is large, when the radius of curvature of a road is small at the distant place, vehicles are the vehicles recognition fields WP. Shell deviation may be carried out. For this reason, aforementioned amendment width-of-face alphaL and alphaR Using a map as shown in drawing 12 , it is determined that a value becomes large as speed V becomes low.

[0029] the following step 412 -- a minimum line 130, amendment width-of-face alphaL, and alphaR the field (field presumed that opposite vehicles exist) of three square shapes predetermined to the right-hand side of the field (field presumed that precedence vehicles exist) surrounded in the approximation straight lines 142 and 144 by which the position was amended -- in addition, the vehicles recognition field WP for carrying out recognition processing of precedence vehicles and the opposite vehicles It determines (refer to drawing 10). In addition, this vehicles recognition field WP Aforementioned amendment width-of-face alphaL according to change of the vehicle speed V and alphaR even if it attaches With change, area is enlarged as the time of a low-speed run comes (refer to drawing 11). In addition, although left-hand traffic is assumed in this example, the field of the triangle which will be presumed that opposite vehicles exist if it is right-hand traffic is added to the left-hand side of the field presumed that the aforementioned precedence vehicles exist.

[0030] if the judgment of Step 406 is denied on the other hand -- Step 414 -- setting -- A>A2 ****** -- by judging, a road judges a right curve way or a left curve way They are amendment width-of-face alphaL according to the vehicle speed V which the road was judged to be a right curve way, read the vehicle speed V of vehicles 10 at Step 416, and was read using the map shown in drawing 12 when a judgment was affirmed, and alphaR. Receiving correction value alphaL' and alphaR' are determined at Step 418. the variation rate which expresses the degree of a curve with the following step 420 -- an amount A -- responding -- amendment width-of-face alphaR of an approximation straight line on either side, and alphaL correction value alphaR' which determined the gain GL and GR for determining using the map shown in drawing 13 and drawing 14 , and was determined at Step 422, and alphaL -- ' and the gain GL and GR -- being based -- final amendment width-of-face alphaR of right and left of a window field, and alphaL It determines.

[0031] At this time, since a road is a curve way, it becomes unsymmetrical [right and left], and the approximation straight lines 142 and 144 serve as a different inclination. For this reason, amendment width-of-face alphaR on either side and alphaL It is set as the independent value. That is, the accuracy to which the precedence vehicles 11 exist [a road] in right-hand side when radius of curvature is small (the amount [Variation rate] A size) is high on a right curve way. Therefore, it is amendment width-of-face alphaR by enlarging right-hand side gain GR. It is amendment width-of-face alphaL by enlarging (referring to drawing 13) and making left-hand side gain GL small. It is made small (refer to drawing 14). Moreover, when radius of curvature is large (the amount [Variation rate] A smallness) and a road makes right-hand side gain GR small on a right curve way, it is amendment width-of-face alphaR. It is amendment width-of-face alphaL by making it small and enlarging left-hand side gain GL. It enlarges. Change of this amendment width of face is shown in drawing 15 as an image.

[0032] Amendment width-of-face alphaL determined at Step 424, and alphaR Vehicles recognition field WP for adding the field of three predetermined square shapes presumed that opposite vehicles exist in the right-hand side of the field surrounded in the approximation straight lines 142 and 144 by which the position was amended like the above, and carrying out recognition processing of precedence vehicles and the opposite vehicles It determines.

[0033] On the other hand, when the judgment of Step 414 is affirmed, it judges that a road is a left curve way, and shifts to Step 426, and the vehicle speed V of vehicles 10 is read. At Step 428, it responds to the vehicle speed V read using the map of drawing 12 , and they are correction value alphaR' on either side and alphaL'. It determines and the gain GL and GR of the right and left according to the amount A of displacement is determined at Step 430. That is, when radius of curvature is small (the amount [Variation rate] A size) and a road makes right-hand side gain GR small on the map shown in drawing 16 on a left curve way since the accuracy to which the precedence vehicles 11 exist in left-hand side is high, it is amendment width-of-face alphaR. It is amendment width-of-face alphaL by enlarging left-hand side gain GL on the map which makes small and is shown in drawing 17 . It enlarges.
[0034] Correction value alphaR' determined at the following step 432, and alphaL' And gain GL, It is based on GR and they are final amendment width-of-face alphaR of right and left of a window field, and alphaL. It determines. Amendment width-of-face alphaR of the right and left determined at Step 434, and alphaL On the right-hand side of the field surrounded in the approximation straight lines 142 and 144 by which the position was amended Vehicles recognition field WP for adding the field of three predetermined square shapes presumed that opposite vehicles exist, and carrying out recognition processing of precedence vehicles and the opposite vehicles It determines.
[0035] It is the vehicles recognition field WP as mentioned above. If determined, it will shift to Step 436, and it is the vehicles recognition field WP as recognition processing of the other car. Inner level edge-detection processing is performed. This level edge-detection processing is the vehicles recognition field WP about detecting a level edge point like edge-detection processing of Step 402 first. It carries out inside. Next, peak point EP of a position that integrate with the detected level edge point in a longitudinal direction, and an integration value exceeds a predetermined value It detects (refer to drawing 8 (B)). This level edge has high possibility of appearing when the other car exists.
[0036] The position coordinate of the other car is calculated at the following step 438. Perpendicular edge-detection processing is performed first. peak point EP of the integration value of a level edge point Peak point EP of being located below on a picture when there are more than one from -- order -- peak point EP The window field WR for detecting a vertical line so that the ends of the level edge point included may be included respectively, and WL It sets up (refer to drawing 8 (C)). This window field WR and WL When the perpendicular edge was detected inside, and vertical lines 138R and 138L are stabilized and are detected, they are the window field WR and WL. It judges with the other car existing in the field across which it faced.
[0037] Next, the window field WR and WL By asking for the interval of the longitudinal direction of the vertical lines 138R and 138L detected in inner each, it asks for breadth of a car, and the coordinate of the center of breadth of a car is searched for as a coordinate (Xi, Yi) of the center of vehicles. It is the vehicles recognition field WP about this processing. By repeating inside, as shown also in drawing 18 as an example, it is the vehicles recognition field WP. The position coordinate of n vehicles (drawing five sets) which exist inside is searched for. In addition, since the detected vertical lines 138R and 138L correspond to the crosswise both ends of the tail section of vehicles, the coordinate (Xi, Yi) expresses the position near the center section of the tail section of the other car. Other car recognition processing is ended by the above, and it shifts to Step 202 of the flow chart of drawing 5 .
[0038] At Step 202, initial setting of the coordinate value (XL, YL) of the vehicles with which the value of a Y coordinate exists in the smallest position in the coordinate value (XR, YR) of the vehicles with which the value of a Y coordinate exists in the smallest position in the right-hand side of the irradiation field used by the gain setting processing mentioned later, and the right-hand side of an irradiation field is performed. Here, the value corresponding to the position of the cutline 70 at the time of a high beam is set as YR, the value corresponding to the position of the cutline 72 at the time of a high beam is set as YL, and any value is set to XR and XL. At Step 204, the value of the area "i" prepared on memory is set to 1, and Step 206 performs incorporation of the coordinate (Xi, Yi) of the vehicles of eye the "i" base among the position coordinates of n vehicles determined by the above-mentioned other car recognition processing.
[0039] At Step 208, the direction position of X of the i-th vehicles judges whether it is located in the

right-hand side in the irradiation field of head lamps 18 and 20, it is located in left-hand side, or it is located in the center based on the value of incorporated Xi. In addition, the right-hand side in an irradiation field here is a field corresponding to the cutline 70 shown in drawing 7 , and the left-hand side of an irradiation field is a field corresponding to a cutline 72. Moreover, when the direction position of X of vehicles is a position concerning a cutline 70 and a cutline 72, it is judged that it is located in the center.

[0040] When vehicles are judged to be located in left-hand side at Step 208, it shifts to Step 210, and it judges whether the value of Yi is smaller than the value of a coordinate value YL. Yi is substituted for YL, Xi is respectively substituted [in / Step 212 / when the judgment of Step 208 is affirmed] for XL, and it shifts to Step 226. On the other hand, when vehicles are judged to be located in right-hand side at Step 208, it shifts to Step 222, and it judges whether the value of Yi is smaller than the value of a coordinate value YR. If this judgment is affirmed, Yi will be substituted for YR, Xi will be respectively substituted for Step 224 at XR, and it will shift to Step 226.

[0041] moreover, when it is judged that it is located in the center of the irradiation field which requires vehicles for cutlines 70 and 72 at Step 208 When it judges whether the value of Yi is smaller than the value of YL at Step 214 and a judgment is affirmed, while substituting Yi for YL and substituting Xi for Step 216 respectively at XL When it judges whether the value of Yi is smaller than the value of YR at the following step 218 and a judgment is affirmed, Yi is substituted for YR, Xi is respectively substituted for Step 216 at XR, and it shifts to Step 226.

[0042] At Step 226, it is recognized by other car recognition processing, and judges whether the above-mentioned processing was performed to all the other cars with which the position was detected. When the judgment of Step 226 is denied, "1" is added to i at Step 228, it returns to Step 206, and processing of Steps 208-226 is repeated based on the coordinate which incorporated and incorporated the coordinate (Xi, Yi) of the following vehicles. Therefore, when n vehicles have been recognized in other car recognition processing of Step 200, after processing of Steps 206-228 is repeated n times, the judgment of Step 226 is affirmed and it shifts to Step 230.

[0043] When the judgment of this step 226 is affirmed, the coordinate of the vehicles with which the value of a Y coordinate exists in the smallest position in the right-hand side (and center) of the irradiation field of a head lamp will be stored in a coordinate value (XR, YR), and the coordinate of the vehicles with which the value of a Y coordinate exists in the smallest position in the left-hand side (and center) of the irradiation field of a head lamp will be stored in a coordinate value (XL, YL). The vehicles which exist in this (XR, YR) position of (XL, YL) are vehicles which are the easiest to give a glare in the right-hand side and left-hand side of an irradiation field. In addition, when vehicles do not exist, or when vehicles exist in the position (namely, very much distant place) higher than the cutline position at the time of the high beam of a head lamp, a coordinate value (XR, YR) and (XL, YL) the value at the time of initial setting are held.

[0044] As processing which defines the gain set as actuators 40, 41, 42, and 43, based on a coordinate value (XR, YR), the gain DEGR of the rotation angle of shading cam 40A is set that the position of a cutline 70 is in agreement with YR, and the gain DEGL of the rotation angle of shading cam 42A is set that the position of a cutline 72 is in agreement with YL at Step 230 based on a coordinate value (XL, YL). The determination of this gain DEGR and DEGL can be defined with reference to the map showing the relation of YR and DEGR which were defined beforehand, for example, and the map showing the relation between YL and DEGL.

[0045] At the following step 232, based on the gain DEGR and DEGL determined above, the motors 40D and 42D of actuators 40 and 42 are driven, and the shading cams 40A and 42A are rotated. In addition, about an actuator 41, it drives [actuator / 43 / as well as an actuator 40] respectively like an actuator 42. Thereby, it is controlled so that the position of the position of a cutline 72 of a cutline 70 corresponds with YL in accordance with YR. As mentioned above, the coordinate of the other car detected by other car recognition processing expresses the position of the center section of the tail section of the other car, and since it is located near the center of the tail section of vehicles a cutline tends to give a glare by this control, a glare is not given to the other car. However, when the position of

YR and YL is lower than the minimum position of a cutline, a cutline is reduced to the aforementioned minimum position.
[0046] Next, the control result of the cutline by the above-mentioned processing is explained. For example, when vehicles exist only in the position (left-hand side of the vehicles 10 front) of the point which gave the sign of "1" to drawing 18 as the other car of the vehicles 10 front, the position of a cutline 72 is controlled in agreement with the position of the point of "1", as an alternate long and short dash line shows to drawing 19 . At this time, although the cutline 70 on the right-hand side of the irradiation range is in the upper limit position shown as a solid line, a glare is not given to the aforementioned vehicles and the driver of vehicles 10 does not feel shortage of the irradiation range.
[0047] Moreover, since the coordinate Y2 of this point is lower than the minimum position of a cutline 72 when vehicles exist also in the position of the point which gave the sign of "2", for example to drawing 18 , the position of a cutline 72 falls to drawing 19 to the minimum position shown with a two-dot chain line. Also at this time, as for a cutline 70, it is maintained in an upper limit position. Moreover, when vehicles exist only in the point of "5" of drawing 18 (right-hand side ahead of vehicles), the position of a cutline 70 is controlled in agreement with the position of the point of "5", as a solid line shows to drawing 20 . At this time, the position of a cutline 72 is maintained in an upper limit position.
[0048] Furthermore, when vehicles exist only in the point of "4" of drawing 18 (center ahead of vehicles), the position of a cutline 70 and a cutline 72 is controlled respectively in agreement with the position of the point of "4", as a two-dot chain line shows to drawing 21 . It is prevented that this gives a glare to the vehicles located in the point of "4." Moreover, since the coordinate Y3 of this point is lower than the minimum position of a cutline 70 and a cutline 72 when vehicles exist in the point of "3" of drawing 18 (similarly center ahead of vehicles), the position of a cutline 70 and a cutline 72 falls to drawing 21 to the minimum position shown with an alternate long and short dash line.
[0049] Thus, since only the position of the cutline in the field where the detected other car exists is controlled when the shading cams 40A and 42A divide the cutline of a head lamp into a cutline 70 and a cutline 72, it constitutes so that each position can be controlled by actuators 40 and 42, and the other car is detected, while giving a glare to the detected other car is prevented, a driver does not feel shortage of the irradiation range.
[0050] Moreover, since the luminous intensity distribution of a head lamp are controlled by this example according to the position of the other car in a picture, detection of the distance between two cars can become unnecessary, and can process an operation etc. in a short time. moreover, in controlling the luminous intensity distribution of a head lamp according to the distance between two cars Although a glare may be given and the amendment need produces the irradiation range (or direction of radiation) according to the aforementioned inclination, an inclination, etc. when the relative position and relative direction of the other car change with the inclination of a road, the inclinations of vehicles, etc., even if the distance between two cars with the other car was fixed Since the sense of TV camera 22 and head lamps 18 and 20 changes according to this even if there are inclination of a road, an inclination of vehicles, etc. in this example Since the picture according to the aforementioned inclination or the inclination is acquired and the luminous intensity distribution of a head lamp are controlled according to the position of the other car in this picture, it is not necessary to perform the aforementioned amendment etc.
[0051] In addition, although the luminous intensity distribution ahead of vehicles were controlled by the shading cam, you may make it shade the light of a head lamp by the gobo or the shutter in the above-mentioned example. Moreover, although luminous intensity distribution are controlled by shading the light of a head lamp, you may make it deflect the injection optical axis of a head lamp.
[0052] Moreover, although a cutline is divided into a cutline 70 and a cutline 72 from a center and it was made to control the position of each cutline by this example by the shading cams 40A and 42A, the number of partitions and the division position of a cutline are not limited to this.
[0053]
[Effect of the Invention] As explained above, in this invention, by changing the irradiation range or the direction of radiation of light respectively Two or more change meanses to make the position of the

boundary of the portion by which the light from a head lamp is irradiated in the field ahead of respectively different vehicles along the vehicles cross direction, and the portion which is not irradiated change are prepared in a head lamp. Since the change means corresponding to the position of the other car was controlled based on the position of the detected other car not to give a glare to the other car when the other car was detected The outstanding effect that the visibility ahead of vehicles can be raised is acquired without giving a glare to the other car.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective diagram seen from the vehicles slanting front which shows the vehicles anterior part used for this example.
[Drawing 2] It is the perspective diagram showing the outline composition of the head lamp which can apply this invention.
[Drawing 3] III-III of drawing 2 It is the cross section which met the line.
[Drawing 4] It is the block diagram showing the outline composition of a control unit.
[Drawing 5] It is a flow chart explaining the control main routine of this example.
[Drawing 6] It is a flow chart explaining other car recognition processing.
[Drawing 7] It is an image view for explaining the cutline displaced with an actuator.
[Drawing 8] The conceptual diagram for the image view of a picture where (A) is picturized by the TV camera at daytime, and (B) explaining level edge point integration processing, and (C) are the conceptual diagrams for explaining perpendicular edge-detection processing.
[Drawing 9] It is the diagram showing the window field at the time of white line recognition.
[Drawing 10] It is the diagram showing a vehicles recognition field.
[Drawing 11] It is an image view for explaining fluctuating a vehicles recognition field according to the vehicle speed.
[Drawing 12] It is the diagram showing the relation between the vehicle speed and the amendment width of face of an approximation straight line.
[Drawing 13] It is the diagram showing a relation with the gain which determines the amendment width of face of the approximation straight line of the degree of a right curve way, and right-hand side.
[Drawing 14] It is the diagram showing a relation with the gain which determines the amendment width of face of the approximation straight line of the degree of a right curve way, and left-hand side.
[Drawing 15] It is the image view showing the window field and amendment width of face to a curve way of different curvature.
[Drawing 16] It is the diagram showing a relation with the gain which determines the amendment width of face of the approximation straight line of the degree of a left curve way, and right-hand side.
[Drawing 17] It is the diagram showing a relation with the gain which determines the amendment width of face of the approximation straight line of the degree of a left curve way, and left-hand side.
[Drawing 18] It is the image view showing an example showing the position of the other car detected by other car recognition processing of a coordinate.
[Drawing 19] It is the image view showing the control result of the position of a cutline when vehicles exist in "1" of drawing 18 , or the position of "2."
[Drawing 20] It is the image view showing the control result of the position of a cutline when vehicles exist in the position of "5" of drawing 18 .
[Drawing 21] It is the image view showing the control result of the position of a cutline when vehicles exist in "3" of drawing 18 , or the position of "4."
[Description of Notations]

18 Head Lamp
20 Head Lamp
22 TV Camera
40 Actuator
42 Actuator
48 Image Processing System
50 Control Unit
70 Cutline
72 Cutline
100 Run Vehicles Detection Equipment

[Translation done.]

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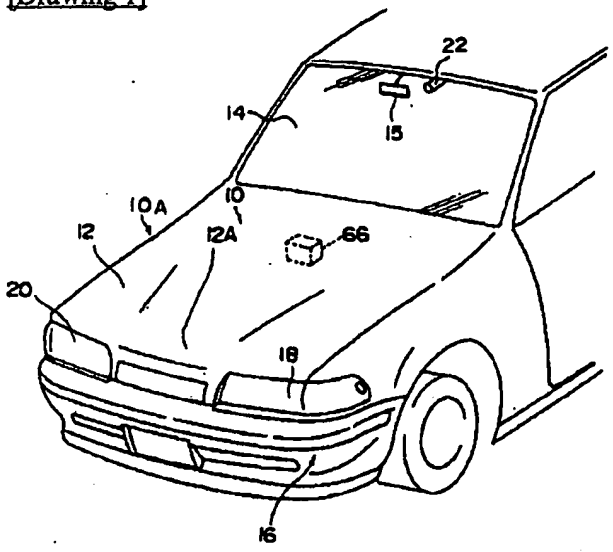
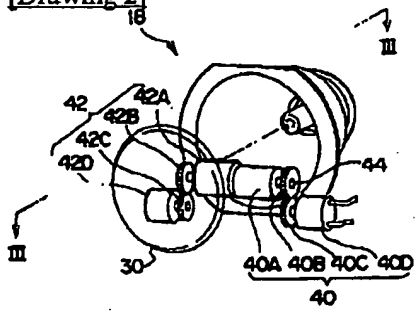
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

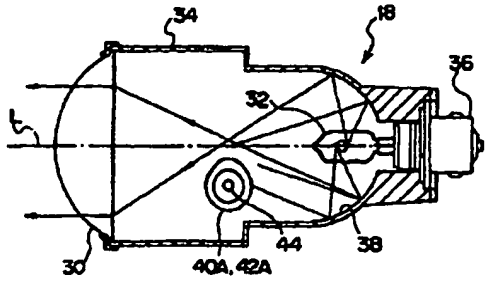
[Drawing 1]



[Drawing 2]



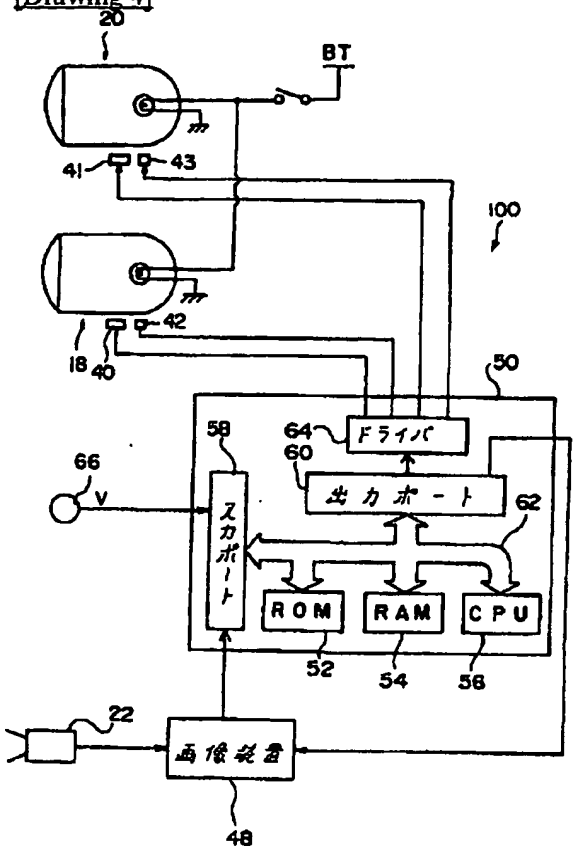
[Drawing 3]



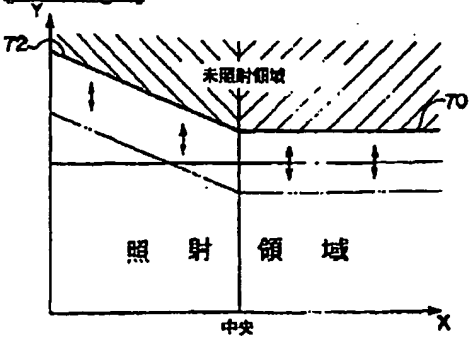
40 アクチュエータ

42 アクチュエータ

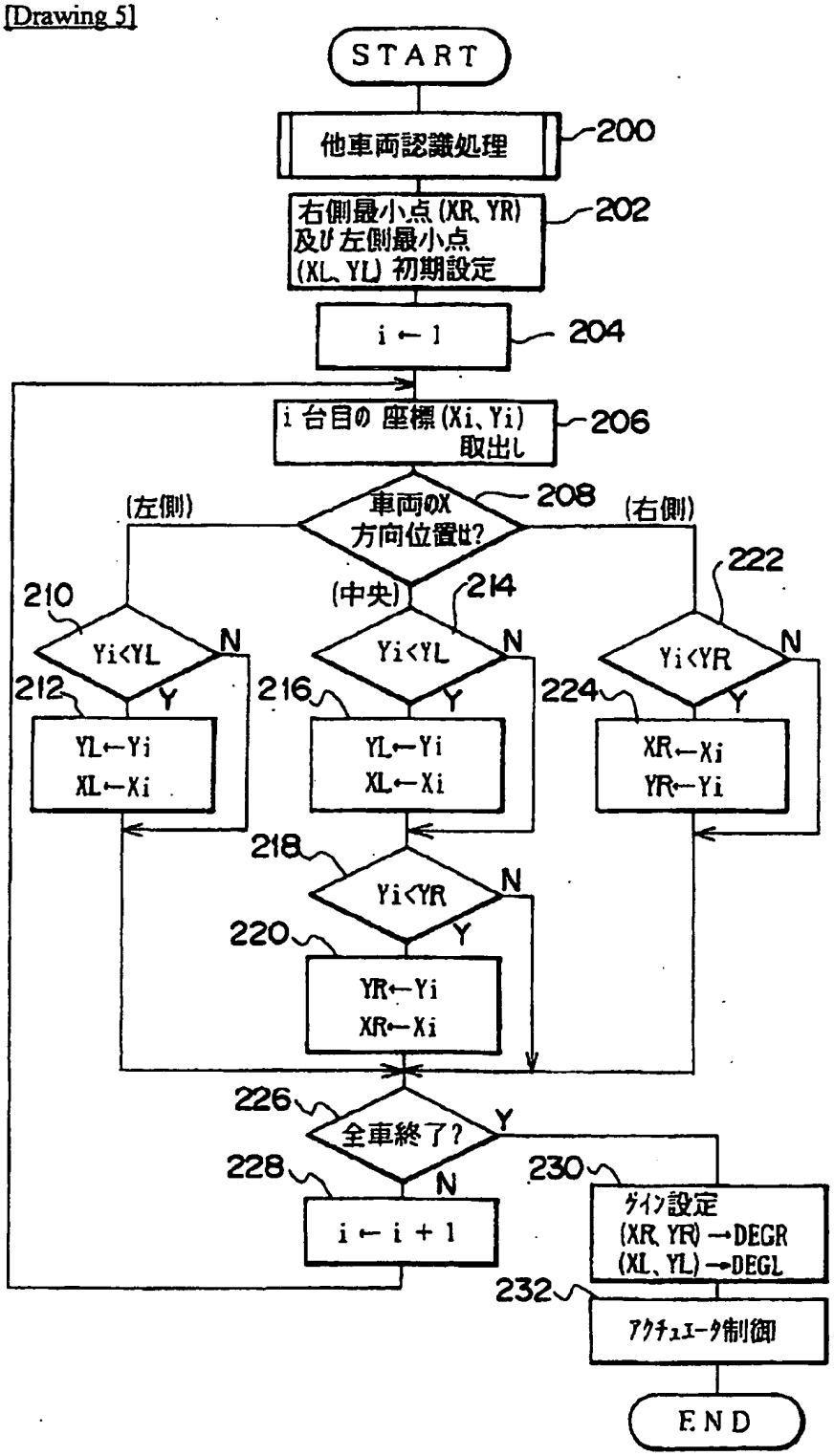
[Drawing 4]



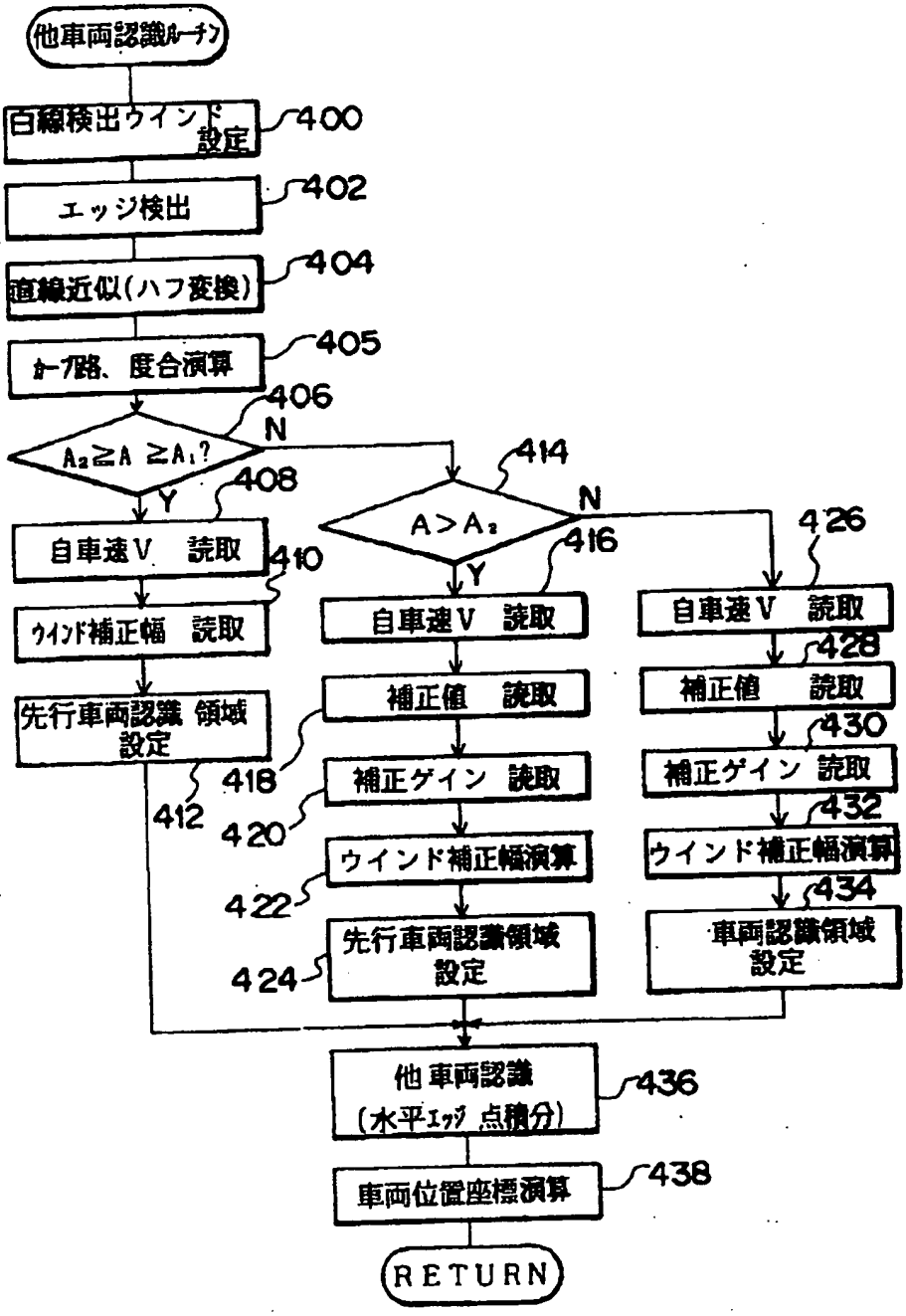
[Drawing 7]



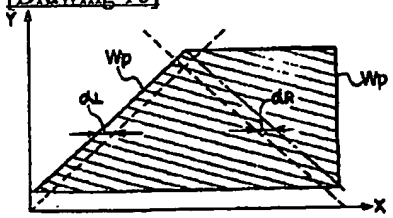
[Drawing 5]



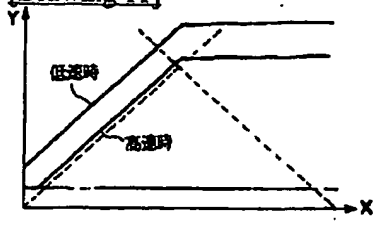
[Drawing 6]


他車両認識ルーチン
白線検出ウインド設定
400
エッジ検出
402
直線近似(ハフ変換)
404
カーブ路、度合演算
405
406
N
A2≧A≧A1?
Y
408
自車速V 読取
410
ウインド補正幅 読取
先行車両認識 領域設定
412
414
A>A2
N
Y
416
自車速V 読取
補正値 読取
418
補正ゲイン 読取
420
ウインド補正幅演算
422
先行車両認識領域設定
424
426
自車速V 読取
428
補正値 読取
430
補正ゲイン 読取
432
ウインド補正幅演算
434
車両認識領域設定
他車両認識
(水平エッジ 点積分)
436
車両位置座標演算
438
RETURN

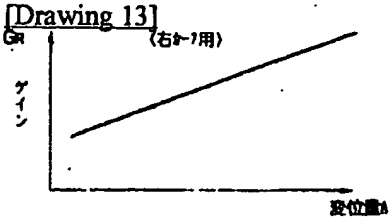
[Drawing 10]


Y
Wp
Wp
dL
dR
X

[Drawing 11]

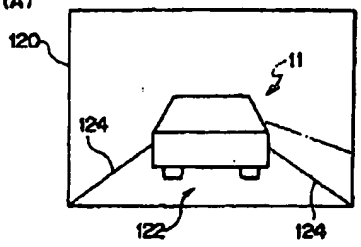


[Drawing 13]

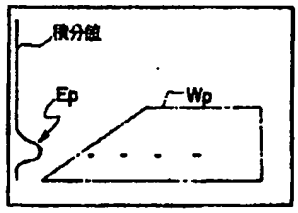


[Drawing 8]

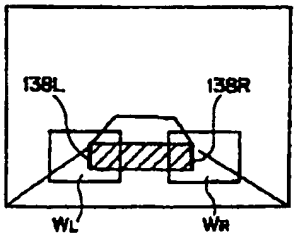
(A)



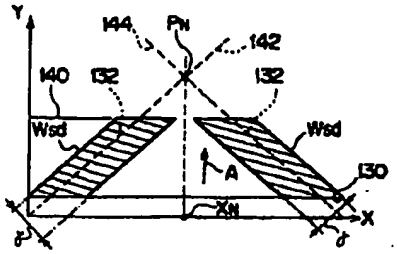
(B)



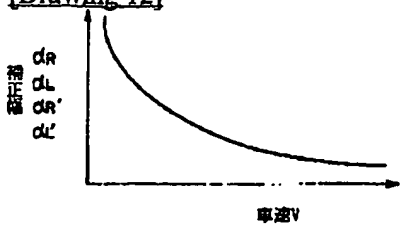
(C)



[Drawing 9]



[Drawing 12]



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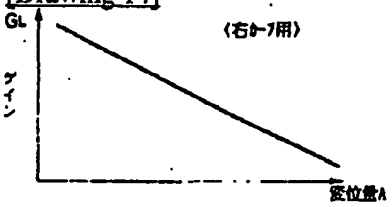
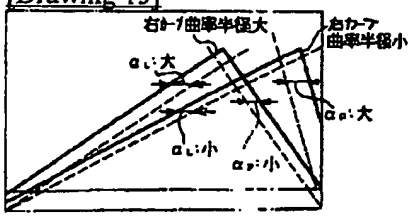
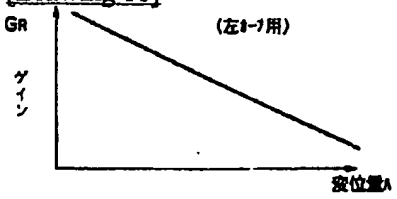


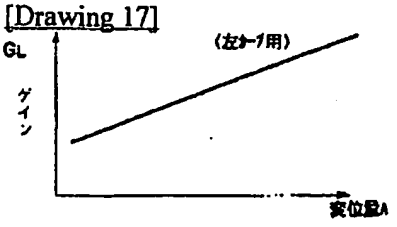
[Drawing 15]



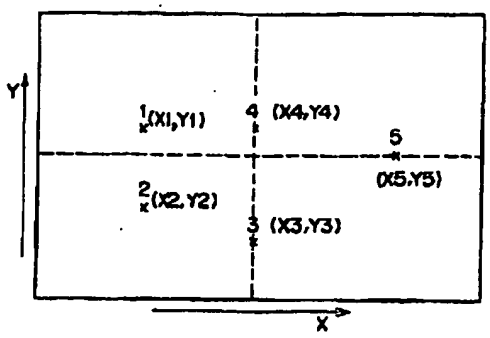
[Drawing 16]



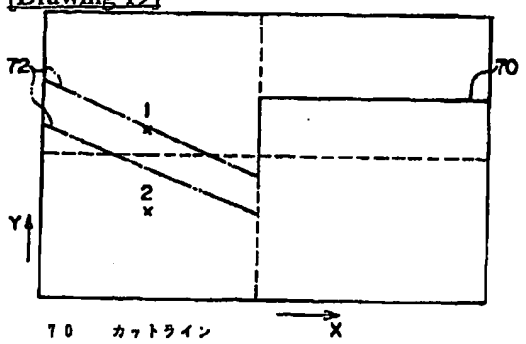
[Drawing 17]



[Drawing 18]

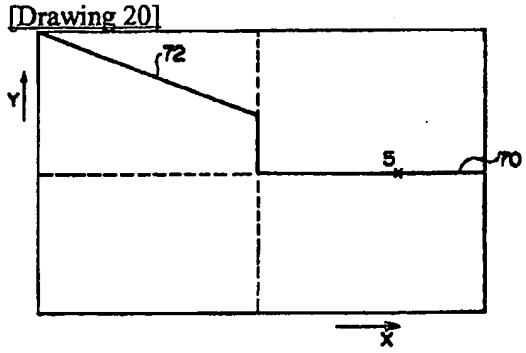


[Drawing 19]

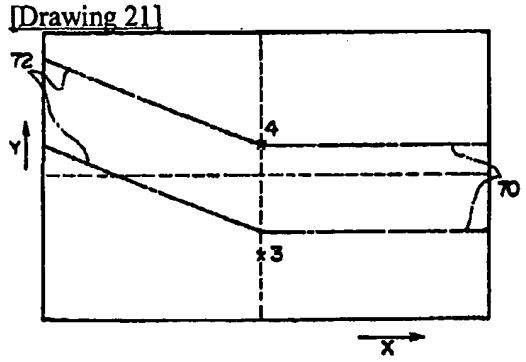


70 カットライン
72 カットライン

[Drawing 20]



[Drawing 21]



[Translation done.]

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(12) PUBLICATION OF UNEXAMINED PATENT APPLICATION (A)

(11) Kokai (Unexamined) Patent Publication Number: 6-267304

(43) Date of Disclosure: September 22 1994

(51) Int. Cl.[5]	Identif. Symbol	Intra-Agency Number	FI	Technology Disclosure
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B 60 Q	1/14		8715-3K	
F 32 M	3/05		9249-3K	
	3/14		9249-3K	
H 04 N	7/18		K	

Examination requested: not yet requested
Number of Claims: 1 OL (total of 12 pages)

(21) Application Number: 5-57031
(22) Filing Date: March 17, 1993

(71) Applicant: 000003207
Toyota Motor Corporation
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(72) Inventor: Masashi MIZUKOSHI
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(74) Agent: Atsushi NAKAJIMA, patent attorney (2 others)

(54) Title of the Invention: HEADLIGH DEVICE FOR VEHICLES

(57) Summary

(Purpose)

The purpose of the invention is to prevent glare from being inflicted upon another vehicle.

(Construction)

Shielding cams 40A, 42A, having a cam shape which can be continuously modified along the circumferential direction of the distance from the rotary axle 44 to the outer periphery, are deployed in the internal part of a headlamp 18. The shielding cams

40A, 42A are rotated separately with motors 40D, 42D. Among the cut lines appearing in front of the vehicle, the position of a cut line on the right side in the direction of the width of the car is modified upward or downward along with the rotations of the shielding cam 42A, while that the position of the cut line on the left side in the car width direction is changed upward or downward along with the rotations of the cam 42A. A control device, not shown in the figure, detects the position of another vehicle based on an image filmed in the forward direction of the vehicle, and the shielding cams are thus controlled to avoid glare from being caused for another vehicle.

[see Figure]

[page 2]

(Scope of the Patent's Claim)

(Claim 1)

Headlamp device for vehicle, having a changing means, which changes the position of a borderline between a part that is illuminated by light emitted from headlamps and a part that is not illuminated by light emitted from headlamps, in respective various regions in front of the vehicle, along the car width direction, by changing the range of illumination or the direction of illumination of respective light rays, wherein multiple headlamps are deployed;

having a detection means, which detects the position of another vehicle;

and a control means, which controls said changing means in accordance with the position of said other vehicle to prevent glare from being inflicted upon said other vehicle, based on the detected position of another car, which is detected with said detection means.

(Detailed Explanation of the Invention)

(0001)
(Sphere of Industrial Use) This invention relates to a headlamp device for a vehicle, in particular, it relates to a headlamp device for a vehicle, which controls the distribution of light of headlamps illuminating the space in front of a vehicle while the vehicle is traveling.

(0002)
(Prior Art Technology) When a pair of headlamps is mounted on the right side and on the left side in the front part of a vehicle, the lamps are turned on at night and in cases

when visual recognition of the region in front of the vehicle is problematic in order to improve the visibility of the driver in the forward direction. Because the construction of these headlamps generally makes it possible to switch the illumination range between two stages from high beams to low beams, when another vehicle, either a preceding vehicle or an oncoming vehicle, is present on the road, drivers often choose low beams to prevent glare, as glare can cause an unpleasant blinding sensation of other drivers. Hovers, if for example a preceding car is far away, etc., and the driver uses low beams, the result is that the driver will see continuous dark sections in front of the car, and if the driver uses high beams, he may inflict glare upon the driver of a preceding car. Therefore, the problem was that it was difficult to set an optimal illumination range in the forward direction of the vehicle.

(0003) Because of that, it has been proposed to install a light shielding plate inside the headlamp to shield the illumination light to make it possible to obtain a satisfactory illumination range without causing glare for other vehicles, by moving said shielding plate in order to control in this manner the borderline (hereinafter, this borderline will be referred to as cut line) between the illuminated region and the non-illuminated region. Another type of technology that has been proposed to prevent glare from being caused for other vehicles by controlling the position of the cut line is to film the situation in front of the car with a CCD camera or the like, so that the distance from a preceding vehicle can be recognized and detected based on the image signal that is output from the CCD camera, and the light distribution of the headlamps is then controlled according to the distance between the vehicles (see Japanese Unexamined Patent Application No. 62-131837).

(0004)
(Problem to Be Solved By This Invention) However, because the control over the cut line position is applied with a shielding plate continuously and along the entire cut line in the width direction of the vehicle, if for example an oncoming vehicle is in a close proximity when no preceding vehicles are present, or if a preceding vehicle is far away, etc., the problem was that the visibility of the driver of the car itself was reduced when an insufficient illumination range was set, without providing satisfactory illumination for the car itself with the light of a traveling car because the cut line position is controlled so as to move it to prevent glare from being caused for an oncoming vehicle.

(0005) In view of the situation explained above, the objective of this invention is to obtain a headlamp device, which can improve the visibility in the forward direction of the vehicle without causing glare for another vehicle.

(0006)
(Means to Solve Problems) In order to achieve the above-mentioned objective according to the headlamp device for vehicle of this invention, multiple headlamps are deployed, which are provided with a changing means, which changes the position of the border between a part that is illuminated and a part that is not illuminated by light obtained from the headlamps in differing regions in the forward direction of the vehicle, which is

changing along the car width direction, by changing the illumination range or the illumination direction of respective light rays;

with a detection means, which detects the position of other cars;

and with a control means, which controls the changing means in response to the position of said other cars, to prevent glare from being inflicted upon said other car, based on the position of another car detected by said detection means.

(0007)
(Operation) According to this invention, the illumination range and the illumination direction of respective light rays is changed along the car width direction, with a plurality of changing means, mounted in a headlamp, which change the position of the boundary between a part that is illuminated and a part that is not illuminated by light emitted from a headlamp in the region in front of the vehicle, which is changing along the car width direction. Because of that, when any 1 of the changing means among the plurality of changing means is used to change the range of illumination or the illumination direction, and a specified region is set, which corresponds to said changing means, this makes it possible to change the position of the boundary between the part that is illuminated by the light and the part that is not illuminated by the light, namely to update the cut line position. In addition, according to this invention, when another vehicle is detected, the control means is controlled according to the position of said other car to avoid causing glare for said other vehicle based on the detected position of this other vehicle. Because the control means is thus controlled in this manner according to the position of another vehicle, control can be exercised to avoid causing glare by simply controlling the cut line position inside the region in which a detected other vehicle is present.

(0008) Because of that, if for example no preceding vehicle is present, or even under conditions when a preceding vehicle is far away from the car in question, but an oncoming vehicle is nearby, etc., only the position of the cut line inside the region in which an oncoming vehicle is present is moved in the downward direction to prevent glare from being caused for an oncoming vehicle. At the same time, since the cut line is not lowered in the part which is outside of said region, for example in the position of the cut line in the region corresponding to the car lane in which the car itself is traveling, this means that the visibility of the driver will not be reduced since an insufficient illumination range will not occur. Because the glare can thus be controlled simply with the position of the cut line which corresponds to the position of another car when another car has been detected, the visibility can be improved without causing glare for another vehicle.

[page 3]

(0009)

(Embodiment) The following is a detailed explanation of an embodiment of the present invention. As shown in Figure 1, an engine hood 12 is mounted in the top surface part of a front body 10A of a vehicle 10, and a front bumper 16 is fixed at one end part, opposite the other end of the car in the car width direction, on the end part of the front body 10A. A pair of headlamps 18, 20 is installed on both end parts in the car width direction between the front bumper 16 and the edge part of the engine hood 12.

(0010) A window shield glass 14 is installed in the vicinity of the rear end part of the engine hood 12, while a room mirror 15 is mounted in the vicinity of the region corresponding to the upper side of the window shield glass 14 inside the vehicle 10. A TV camera 22 is installed in order to film the situation in the forward direction of the car in the vicinity of the room mirror 15. This TV camera 22 is connected to an image processing device 48 (See Figure 4). In the present embodiment, the TV camera 22 is a TV camera which is equipped with a CCD element which simply detects only the light amount in order to output an image signal displaying a black and white image.

(0011) In addition, because the position in which the TV camera 22 is arranged should make it possible to recognize with precision the shape of the road in the forward direction of the vehicle, and because the position should also match the visual angle of the driver, it is desirable when the camera is deployed as close as possible to the viewpoint position of the driver (a so called eye point). Further, the shape of the road in this embodiment of the invention includes a continuously progressing road shape, for example a road shape corresponding to 1 car lane formed with a center line and a right edge, etc.

(0012) Further, because a speedometer is also installed in the vehicle 10, in a group of instruments, not shown in the figure, the vehicle velocity V of the vehicle 10 can be detected with a vehicle velocity sensor 66 (see Figure 4) installed in the vehicle. This vehicle velocity sensor 66, which is connected to the image processing device 48, outputs the result of the detection of the vehicle velocity V.

(0013) As shown in Figure 2 and Figure 3, the headlamp 18, which is a projector type of head lamp, is equipped with a convex lens 30, a bulb 32 and with a lamp housing 34. The lamp housing 34, which is fixed roughly in the horizontal direction in a frame, not shown in the figure, of the vehicle 10, is provided on one side with an opening in which the convex lens 30 is fixed, while the light bulb 32 is fixed via a socket 36 in the light emission point of the optical axis L of the concave lens 30 (central axis of the concave lens 30), in the opening on the other side of the lamp housing.

(0014) Because a reflector 38 is formed by an elliptical reflecting face on the side of the bulb, which is inserted inside the lamp housing 34, the light which is emitted from the bulb 38 and reflected from the reflector 38 is condensed between the light bulb 32 and the convex lens 30. Actuators 40, 42 are disposed in the vicinity of the condensing point of this light. The actuator 40 is equipped with a shielding cam 40A, axially supported to enable rotations by rotary axle 44, which is fixed in the car width direction inside the lamp housing 34, while this shielding cam 40A is fixed to a toothed wheel 40B. This

toothed wheel 40B is engaged by a toothed wheel 40C, which is fixed on the driving axle of a motor 40D, and the motor 40 D is connected to a driver 64 of a control device 50.

(0015) In addition, similarly to the actuator 40, the actuator 42 is also connected to the shielding cam 42A, and axially supported to enable rotations along said rotational axis, while the construction also includes a toothed wheel 40B which is fixed on the shielding cam 40A, a motor 42D, and a toothed wheel 40 B which is attached to the driving axle on the motor 42D and engaged by a toothed wheel 40C. The motor 40 D is also connected to a driver 64 of a control device 50. The light of the lamp 32, which is reflected and condensed by the reflector 38, is shielded by the cams 40A, 42A of the actuators 40, 42 so that the remaining light is emitted from the convex lens 30.

(0016) Said shielding cams 40A, 42A are provided with a cam shape which can be continuously changed along the circumferential direction of the distance from the rotary axle 44 to the outer periphery, while the motor 40D can be driven to induce rotational movements in response to signals obtained from a central control unit 50 so as to induce separate rotations of motors 40 D, 42D. Along with the rotation of the shielding cams 40A, 42A, the light from the bulb 32 is analyzed and divided in the boundary position, which can be moved upward or downward, into light which is allowed to pass through and into shielded light. This boundary will appear as a cut line representing the boundary between a bright and a dark region with the light distributed in the forward direction of the vehicle 10.

(0017) As shown in Figure 7, said boundary which is formed by the shielding cam 40A, appears as a cut line 70 on the right side in the car width direction inside the region which is illuminated by the headlamp 18, so that when the shielding cam 40A is rotated, the position of the cut line 70 is moved in parallel from the uppermost position (the position of the so called high beams, being the position indicated by the full line in the cut line 70 shown in Figure 7), to the lowermost position (position corresponding to so called low beams, being the position indicated as an imaginary line in Figure 7).

(0018) Also, said boundary which is formed by the shielding cam 42A, appears as a cut line 72 on the left side in the car width direction inside the illuminated region, so that when the shielding cam 42A is rotated, the position of the cut line 72 is moved in parallel from the uppermost position (the position indicated by the full line in Figure 7, the position of the so called high beams) up to the lowermost position (the position indicated by the imaginary line in Figure 7, the position of so called low beams).

(0019) Further, because the headlamp 20 has the same construction as the construction of the headlamp 18, a detailed description thereof will be omitted. As shown in Figure 4, actuators 41, 43 are installed so that the position of the cut line can be moved independently on the right side and on the left side of the illuminated region along with the operation of the actuators 41, 43.

(0020) As shown in Figure 4, the construction of the control device 52 comprises a reading only memory (ROM) 52, a random access memory (RAM) 54, a central processing unit (CPU) 56, and an input port 58, and an output port 60, which are connected to a bus 62, such as a data bus, a controller bus, etc.

[page 4]

In addition, a map and control program, which will be explained later, is stored in this ROM 52.

(0021) A vehicle velocity sensor 66 and an image processing device 48 are also connected to the input port 58. This image processing device 48 performs image processing operations applied to images filmed with the TV camera 22 based on the signal which is input from the TV camera 22 and from the control device 50 as will be explained later. The output port 60 is connected via the driver 64 to the actuators 40, 42 of the headlamp 18, and to the actuators 41, 43 of the headlamp 20. Moreover, the output port 60 is also connected to the image processing device 48.

(0022) An explanation of the operation of the present embodiment will be provided next with reference to Figure 5 and Figure 6. When the driver of this vehicle 10 turns on a light switch, not shown in the figure, the head lamps 18, 20 are lit up, and the control routine indicated in Figure 5 will be realized in each specified time interval. During step 200 of this control routine, when the recognition processing of another vehicle is conducted and another car is recognized as a an oncoming vehicle, an oncoming vehicle is recognized, while a car traveling so that it is in front of the car in question is recognized as a preceding vehicle. The reference provided in the flowchart in Figure 6 explains the recognition processing during the recognition of another vehicle.

(0023) As shown in Figure 8 (A), the figure indicates one example of the situation when the vehicle 10, which is traveling on a road 122, films the image of the road with a TV camera 22, wherein the image which is visually perceived by the driver is roughly coincident with the image of this example (image 120). This road 122 is provided with a white line 124 on both sides of the car lane in which the car 10 is traveling. In addition, each image element in said image is specified by its position determined by a coordinate (X_D, Y_D,) in a system of coordinates determined by intersecting axes, axis X and axis Y, set up in the image. The following recognition operations are performed during the recognition of another vehicle based on this image.

(0024) During step 400, a region having a specified width γ in the image is set as white line detection widow region W_{sd} as shown in Figure 9. In this embodiment, it is assumed that only an image corresponding to some 40 ~ 50 m can be detected in the forward direction of a vehicle 10 as the vehicle 10 is traveling at night, so that detection of the white line in a position exceeding 60 m in front of the vehicle 10 is not conducted .In

addition, the probability that another vehicle will be present in the region in the lower part of the image is low. Because of that, when the width line detection window region W_{sd} is set to enable detection up to 60 m in the forward direction of the vehicle 10, the white line detection window region W_{SD} is set so that the region below the lower limit line 130 and above the upper limit of a specified horizontal line 140 is excluded.

(0025) Next, during the step 402, the bright region inside the window region W_{SD} is differentiated and the peak point of this differential value (maximum point) is extracted as the edge point, representing a white line candidate point. In other words, the brightness of each element in a horizontal line is differentiated from the image elements in the lowermost position to the image elements in the uppermost position in the vertical direction inside the window region W_{SD} (the direction of the arrow A in Figure 9), and the peak point of the large differential value is extracted as the edge point of brightness fluctuations. Therefore, continuous edge points can be extracted so that detection inside the white detection line window W_{SD} can be performed as indicated by the broken line 132 shown in the example in Figure 9.

(0026) Direct line approximation processing operations are conducted in step 404. During this processing, straight line approximation is performed by applying Hough transform to the edge points extracted during the white line candidate point extraction processing, and approximately straight lines 142, 144 are determined along the white line and an estimated line. Next, in step 405, the intersection point P_N of the determined approximately straight line is determined (X coordinate value = X_N), and using this determined intersection point P_N as a standard, the displacement amount A ($A = X_N - X_O$) is determined in the horizontal direction of the intersection point P_O (X coordinate value = X_O) of a straight line determined in advance. This displacement amount A corresponds to the extent of the curve of the road 122.

(0027) Next, during step 406, it is determined whether the road 122 is roughly a straight road by determining whether the displacement amount A is or is not within the range of $A_2 \geq A \geq A_1$. This determined standard value A_1 is a standard value displaying the boundary between a road in a straight line and a road having a right curve, while the standard value A_2 is a standard value displaying the boundary between a road in a straight line and a road having a left curve. When it has been determined that the road is a straight line road in step 406, the vehicle velocity V of the car 10 itself is read in step 408.

(0028) Next, during step 410, when a preceding vehicle and an oncoming vehicle is recognized according to the read vehicle velocity V and the vehicle recognition region W_P is set, the position of an approximately straight line is corrected by setting correction amounts α_L, α_R. Because turns can be made only on roads enabling a large curvature radius during travel at a high speed, the traveled road is considered to run roughly in a straight line. However, since a small curvature radius enables turning during traveling at a low speed, even if the road immediately in front of the vehicle runs almost in a straight line, there is a possibility that the vehicle may deviate from the car recognition region W_P if the curvature radius of the road in the distance is small. Because of that, a larger value

is determined in accordance with a lower vehicle velocity V while using said correction widths α_L, α_R as a map as shown in Figure 12.

(0029) Next, in step 412, a region is added on the right side of the region which is surrounded by approximately straight lines 142, 144, (as the region in which a preceding vehicle is assumed to be present), and a specified region is added having a triangular shape (as the region in which an oncoming vehicle is assumed to be present), and the vehicle recognition region S_P is determined for recognition processing of a preceding vehicle and of an oncoming vehicle. In addition, the surface area of this vehicle recognition region W_P is also increased during travel at a low speed along with the changes of said correction widths α_L, α_R corresponding to the changes of the vehicle velocity V (see Figure 11). Further, although it is assumed in the present invention that passing is enabled on the left side, if the right side is the passing side, a region having a triangular shape in which an oncoming vehicle is assumed to be present can be added on the left side of the region in which said preceding vehicle is assumed to be present.

(0030) On the other hand, if the determination obtained in step 406 is a negative determination, it will be determined in step 414 whether the statement $A > A_2$ is true, and based on this determination, it will be determined whether the road is a road which has a right curve, or a road which has a left curve.

[page 5]

If a positive determination is made in this case, and it is determined that the road has a right curve, the vehicle velocity V of the vehicle 10 is read in step 416, and using the map shown in Figure 12, correction widths $\alpha_{L'}$, $\alpha_{R'}$ are set in step 418 for the left and right correction widths α_L, α_R. Next, in step 420, in order to determine the correction widths α_L, α_R for an approximately straight line on the left and on the right according to the displacement amount A displaying the extent of the curve, the gains GL, GR are set using the maps shown in Figure 13 and Figure 14. In step 422, the correction widths α_L, α_R are set for the final window region based on the gains GL, GR, and on the determined correction values $\alpha_{L'}$, $\alpha_{R'}$.

(0031) Because at this point, the road is a curved road, asymmetry is created between the left and right side, resulting in a different inclination for the approximately straight lines 142, 144. Because of that, the values for the left and right correction widths α_L, α_R are set independently. In other words, when the road is a road which has a right curve and a small radius of curvature (a large displacement amount A), there is a high probability that a preceding vehicle will be present on the right side. Accordingly, a larger correction width α_R is created by setting a larger gain GR on the right side (see Figure 13), and the correction width α_L is decreased by reducing the gain GL on the left side (see Figure 14). Also, if the road is a road with a right curve and a large radius of curvature (a small displacement amount A), the correction width α_R is decreased by reducing the gain GR

on the right side, and the correction width α_L is increased by increasing the gain GL on the left side. Figure 15 shows an image indicating these correction width changes.

(0032) In step 424, on the right side of the region surrounded by the approximately straight lines 142, 144 in the position determined with the correction widths α_L, α_R is added a specified triangular region in which an oncoming vehicle is estimated to be present in the same manner as described above, and the vehicle recognition regions P_W is set for recognition processing of a preceding vehicle and of an oncoming vehicle.

(0033) On the other hand, if the determination in step 414 is a positive determination, it will be determined that the road has a right curve, the operation will proceed with step 426, and the vehicle velocity of the vehicle 10 will be read. In step 428, the correction values α_L, α_R are set for the left and for the right side according to the read vehicle velocity V by using the map shown in Figure 12, and the gains GL, GR on the left and on the right are set according to the displacement amount A in step 430. Specifically, because there is a high probability that a preceding vehicle 11 will be present on the left side when the road has a left curve with a small radius of curvature (large displacement amount A), the correction width α_R is decreased by reducing the gain GR on the right side with the map shown in Figure 16. In addition, the correction width α_L is increased by increasing the gain GL on the left side with the map shown in Figure 17.

(0034) Next, during step 432, the correction widths α_R, α_L on the left and on the right of the final region are set based on the determined correction values $\alpha_{R'}$, $\alpha_{L'}$ and based on gains GL, GR. In step 434, and on the right side of the region surrounded by the approximately straight lines 142, 144, corrected with the determined correction widths α_R, α_L on the left and on the right, is added a specified triangular region in which an oncoming vehicle is estimated to be present, which is set as a vehicle recognition region W_P to perform recognition processing for recognition of a preceding vehicle or of an oncoming vehicle.

(0035) When the preceding vehicle recognition region W_P has been set as explained above, the operation proceeds with step 436, recognition processing is conducted for recognition of another vehicle and horizontal edge detection processing is conducted inside the vehicle recognition region W_P. During this horizontal edge detection processing, the edge detection is first conducted in the same manner as in step 402, and the detection processing operation is performed inside the vehicle recognition region W_P by detecting the horizontal edge point. Next, the detected horizontal edge points are integrated in the lengthwise direction, a peak point E_P is detected if the integrated value is exceeded (see Figure 8 (B)). There is a high probability that another vehicle will appear in this horizontal edge.

(0036) Next, the coordinate positions of another vehicle are calculated during step 438. First, the horizontal edge detection processing is conducted. If there are multiple peak points E_P of the integrated value of the horizontal edge point, window regions W_R, W_L are set up for detection of the vertical line so as to include both ends of the horizontal

edge point containing the peak points E_P from the side of the peak point E_P in the lower position of the image (see Figure 8 (C). When a vertical edge is detected inside these windows W_R, W_L, it is determined that another vehicle is present in the region surrounded by the windows W_R, W_L when stabilized vertical lines 138R, 138L have been detected.

(0037) Next, the car width is determined by determining the interval in the horizontal direction of each of the vertical lines 138R, 138L detected inside the windows W_R, W_L, and the coordinates of the center of the vehicle (Xi, Yi) are determined as the coordinates of the center of the car width. By repeating this processing inside the vehicle recognition region W_P, as shown in Figure 18, the coordinate values of n vehicles are determined (5 vehicles in the figure), which are determined to be present inside the car recognition region W_P. In addition, because the detected vertical lines 138R, 138L correspond to the end parts in the car width direction of the tail part of the vehicle, the coordinates (Xi, Yi) display a position in the vicinity of the central part of the tail part of another vehicle. When recognition processing performed to recognize another vehicle as explained above is completed, the operation proceeds with step 202 indicated in the flowchart shown in Figure 5.

(0038) During step 202, processing of the gain setting is used as will be explained later, and the initial setting of the coordinate (XL, YL) is realized for vehicles present in a position having the smallest value of the Y coordinate on the right side of the illuminated region, as well as for coordinate values (XR, YR) of vehicles present in a position having the smallest value of the Y coordinate on the right side of the illuminated region. In this case, value corresponding to the position of the cut line 70 is set to YR during high beams, the value corresponding to the position of the cut line 72 is set to YL during high beams, while the value for XR, XL can be set to any value. The value of "i", created in the memory, is set to 1 in step 204. In step 206, the coordinates (Xi, Yi) of the car corresponding to the "i" value are read from among the position coordinates of n cars determined during recognition processing of other cars as described above.

(0039) Based on the value Xi which was read in step 208, it will be determined that either the position in direction X of the first vehicle is a position on the right side inside the region which is illuminated by the headlamps 18, 20, or that it is in a position on the left side, or in a position in the center.

[page 6]

In addition, the right side within this illuminated region is a region corresponding to the cut line 70 shown in Figure 7, and the left side of this illuminated region corresponds to the cut line 72. Moreover, if the X direction position of the vehicle was a position applied to the cut line 70 and cut line 72, the central position is determined.

(0040) If it is determined in step 208 that the position of a vehicle is on the left side, the operation proceeds with step 210 and it is determined whether the value of Yi is or is not smaller than the coordinate value YL. If the determination in step 208 is a positive determination, in step 212, YL is replaced by Yi, and XL is replaced by Xi and the operation proceeds with step 226. On the other hand, if it has been determined in step 208 that a vehicle is present on the right side, the operation proceeds with step 222 and it is determined whether the value of Yi is or is not smaller than the coordinate value YR. If this determination is a positive determination, in step 224, YR is replaced by YI, and XR is replaced by Xi, and the operation proceeds with step 226.

(0041) Also, if it has been determined in step 208 that a vehicle is positioned in the central position of the illuminated region applicable to the cut line 71, 72, it is determined in step 214 whether the value of Yi is or is not smaller than the value of YL. If the determination is a positive determination, YL is replaced by Yi in step 216, and XL is replaced by Xi. At the same time, during the next step 218, it is determined whether the value of Yi is or is not smaller than the value of YR, and if it is a positive determination, YR is replaced by Yi in step 216, XR is replaced by Xi, and the operation proceeds with step 226.

(0042) In step 226, if an other vehicle has been recognized during recognition processing, it is determined whether the processing described above has or has not been applied to all other vehicles whose position has been detected. If the determination in step 226 is a negative determination, "1" is added to "i" in step 228 and the operation is returned to step 206. Next, the vehicle coordinates (Xi, Yi) are read, and based on the incorporated coordinate standard, the processing of step 208 ~ 226 is repeated. Accordingly, if n vehicles have been recognized during recognition processing run in step 200 to recognize other vehicles, once the processing of steps 206 ~ 228 has been repeated n times and the determination in step 226 is a positive determination, the operation proceeds with step 230.

(0043) When the determination made in this stop 225 is a positive determination, the coordinate of the vehicle present in the position having the smallest value in the Y coordinates on the right side (and the center) of the region illuminated by the headlamps are stored for coordinate values (XR, YR), and the coordinates of the vehicle present in the position having the smallest value of the Y coordinates on the left side (and the center) of the region illuminated by the headlamps is stored for the coordinate values (XL, YO). The vehicle which is present in this position (XR, YR), (XL, YL) is a vehicle onto which glare can be easily inflicted on the right side and on the left side of the illuminated region. Also, if no vehicle is present, or if a vehicle was present in a position that is higher than the cut line position during the high beams position of the headlights (i. e. the vehicle is far away), the coordinate values that were set during the initializing procedure (XR, YR) and (XL, YL) will be maintained.

(0044) During the processing run in step 230, the processing determines the gain set by actuators 40, 41, 42, 43, and based on the coordinate values (XR, YR), the gain DEGR is

determined for the rotational angle of the shielding cam 40A so that the position of the cut line 70 will be coincident with YR, and based on the coordinate value (XL, YL), the gain DEGL is determined for the rotational angle of the shielding cam 42A so that the position of the cut line 72 will be coincident with YL. The setting of these gains DEGR, DEGL can be used to determine a reference map displaying the relationship between YR and DEGR, determined for example ahead of time, and a map displaying the relationship and between YL and DGL.

(0045) Next, during step 232, motors 40D, 42D are driving the actuators 40, 42 based on the gains DEGR, DEGL determined as described above, and the shielding cams 40A, 42A are rotated. In addition, the actuator 41 is operated in the same manner as the actuator 40, and the actuator 42 is operated in the same manner as the actuator 43. Because of that, the position of the cut line 70 is controlled so that it is coincident with YR, and the position of cut line 72 is controlled so that it will be coincident with YL. As was explained above, because the coordinates of another car, when another car has been detected during the recognition processing for recognition of other cars, express the position in the central part of the tail part of another car, glare will not be inflicted upon another vehicle since the cut line controls the positioning near the central part of the tail part of a vehicle where it is very easy for glare to occur. However, when the YR, YL position is lower than the lower limit position of the cut line, the cut line is lowered all the way to said lower limit position.

(0046) The following is an explanation of the result of this control of the cut line obtained during the processing explained above. If for example another vehicle is in front of vehicle 10 when a vehicle is present only in a position in which symbol "1" is allocated in Figure 18 (on the left side in front of the vehicle 10), the position of the cut line 72 is controlled so as to be coincident with the position of the point "1" indicated by the one dot chain line in Figure 19. At this point, although the cut line 70 on the right side of the illuminated range is in the position of the upper limit indicated by the full line, glare will not be inflicted upon said vehicle, and the driver of the vehicle 10 will not feel that the illumination range is insufficient.

(0047) Also, when a vehicle is present in the position indicated by symbol "2" in Figure 18, because the coordinate Y2 in this point is lower than the lower limit position of the cut line 72, the position of the cut line 72 will be lowered all the way to the lower limit position indicated by the two dot chain line in Figure 19. At this point, the cut line 70 will be maintained in the position of the upper limit. Also, if only a vehicle is present which is indicated by "5" in Figure 18 (on the right side, in front of the vehicle), the position of the cut line 70 is controlled so as to be coincident with the position of the point "5" indicated by the full line in Figure 20. At this point, the position of the cut line 72 will be maintained in the position of the upper limit.

(0048) Further, when a vehicle is present only as shown by point "4" in Figure 18, the position of the cut line 70 and of the cut line 72 will be controlled so as to be in each case coincident with point "4" indicated in Figure 21 by the two dot chain line.

This makes it possible to prevent glare from being caused for a vehicle which is positioned in the position indicated by point "4", Also, even if a vehicle was present in point "3" shown in Figure 18 (center in front of the same vehicle), because the coordinate Y3 of this point 3 is lower than the lowest position of the cut line 70 and the cut line 72, the position of the cut line 70 and the cut line 72 will be lowered to the lower limit shown by the one dot chain line in Figure 21.

(0049) Therefore, when the cut lines of the headlamps are divided in this manner by the shielding cams 40A, 42A into the cut line 70 and the cut line 72, and a construction is created making it possible to control each position with the actuators 40, 42, since only the position of the cut line is controlled inside the region in which another detected vehicle is present, this makes it possible to prevent glare from being caused for another detected vehicle, while at the same time, the driver will not feel that the range of illumination is insufficient.

(0050) Also, the time required for calculations and the like can be reduced because detection of the distance between the vehicles is unnecessary, as the distribution of the light from the headlamps corresponds to the position of another car in the present embodiment. Moreover, when the distribution of the light from the headlights is controlled so as to correspond to the distance between the vehicles, since there is a possibility that glare will be generated even with a constant distance between the car itself and another vehicle due to factors such as a sloping road, or the inclination of the car and changes of the relative position of another car, it may be necessary to applying a correction to the illumination range (or illumination direction) corresponding to said slope or inclination. In the present embodiment, even if a sloping road is encountered, or if the car has an inclination or the like, since these changes will be picked up with a TV camera 22 and the direction of the headlamps will be changed, when an image of said slope and inclination is obtained, the distribution of the light obtained from the headlamp is controlled according to the position of another vehicle in this picture, so that it is not necessary to apply said correction.

(0051) Further, although the distribution of light in front of the vehicle was controlled with a shielding cam in said embodiment, it is also possible to distribute the light of the headlamps with a shutter. And although the distribution of the light from the headlamps was controlled by shielding of the light, it is also possible to deflect the optical axis along which the light is emitted from the headlamps.

(0052) Furthermore, although the position of each cut line was controlled so that the cut lines were segmented into a cut line 70 and a cut line 72 by the shielding cams 40A, 42A, the invention is not limited to this number of the cut line segments or to this segmenting position.

(0053)
(Effect of the Invention) As was explained above in an embodiment of this invention, when the range of illumination or the direction of illumination of light is changed so that the light which is emitted from headlamps creates an illuminated part and a non-illuminated part in various regions in front of the vehicle along the axial direction of the vehicle, wherein multiple changing means are deployed in the headlamps, which change the position of the boundary between the part that is illuminated by this light and the part that is not illuminated by this light, this makes it possible to exercise control with a changing means in accordance with the position of another vehicle to prevent glare from being inflicted upon another vehicle based on the position of another detected vehicle. The excellent effect obtained in this manner makes it possible to prevent glare from being caused for another vehicle while the visibility of the driver is improvement in front of the vehicle.

(Brief Explanation of Figures)

(Figure 1)

A perspective view of the front of a vehicle showing front par of a vehicle using an embodiment of this invention.

(Figure 2)

A perspective view showing a simplified construction of a headlamp compatible with the present invention.

(Figure 3)

A cross-sectional view along the line III – III shown in Figure 2.

(Figure 4)

A block diagram explaining a simplified construction of a control device.

(Figure 5)

A flowchart explaining the main control routine of an embodiment of this invention.

(Figure 6)

A flowchart explaining recognition processing for recognition of another vehicle.

(Figure 7)

An image diagram explaining displacement of cut lines with actuators.

(Figure 8)

(A) An image diagram of an image filmed with a TV camera during daytime, (B) a simplified diagram used to explain differential processing of horizontal edge points, (C) a simplified diagram used to explain vertical edge detection processing.

(Figure 9)

A graph indicating a window region during white line recognition operations.

(Figure 10)

A graph showing a vehicle recognition region.

(Figure 11)

An image diagram used to explain changes of the vehicle recognition region in response to vehicle velocity.

(Figure 12)

A graph showing the relationship between the vehicle velocity and the correction value of an approximately straight line.

(Figure 13)

A graph showing the relationship between the extent of the right curve and the gain setting the correction width for the approximately straight line on the right side.

(Figure 14)

A graph showing the relationship between the extent of the right curve and the gain setting the correction width for the approximately straight line on the left side.

(Figure 15)

An image diagram indicating the window region and the correction widths with a curve road having a differing radius of curvature.

(Figure 16)

A graph indicating the ratio between the extent of the left curve in the road and the gain setting the correction width of an approximately straight line on the right side.

(Figure 17)

A graph indicating the ratio between the extent of the left curve in the road and the gain setting the correction width of an approximately straight line on the left side.

(Figure 18)

An image diagram showing one example of coordinates expressing the position of other vehicles detected during recognition processing for recognition of other vehicles.

(Figure 19)

An image diagram showing the control results when the position of the cut line is controlled in a case when a vehicle was present in the position indicated by "1" or "2" in Figure 18.

(Figure 20)

An image diagram showing the control results when the position of the cut line is controlled in a case when a vehicle was present in the position indicated by "5" in Figure 18.

(Figure 21)

An image diagram showing the control results when the cut line position is controlled in a case when a vehicle was present in the position indicated by "3" or "4" in Figure 18.

(Explanation of Symbols)

18 headlamp
20 headlamp
22 TV camera

[page 8]

40 actuator
42 actuator
48 image processing device
50 control device
70 cut line
72 cut line
100 vehicle travel detecting device

Figure 1

Figure 2

Figure 3

40 actuator
42 actuator

Figure 4

48 image device
58 input port
60 output port
64 driver

Figure 7

1 non-illuminated region
2 illuminated region

[page 9]

Figure 5

(A) START
200 recognition processing for recognition of another vehicle
202 the minimum point on the right side (XR, YR) and the minimum point on the left side (XL, YL) set during the initialization setting
206 the coordinates of car "i" (Xi, Yi) are incorporated
(B) (left side)
(C) (right side)
(C1) (center)
208 Position in the X direction of the vehicle?
226 All vehicles finished?
230 gain setting
232 actuator control
(D) END

[page 10]

Figure 6

(A) recognition routine for recognition of another vehicle
400 white line detection window is set
402 edge detection
404 straight line approximation (Hough transform)
405 the extent of the curve in the road is calculated
408 the vehicle velocity of the car itself is read
410 the window correction width is read
412 vehicle recognition region for recognition of a preceding vehicle is set

416 vehicle velocity V of the car itself is read
418 correction value is read
420 correction gain is read
422 window correction calculation
424 vehicle recognition for recognition of a preceding car is set

426 vehicle velocity V of the car itself is read
428 correction value is read
430 correction gain is read
432 window correction calculation
434 vehicle recognition region is set

436 vehicle recognition for recognition of another car (horizontal edge point integration)
438 the coordinates of the position of another vehicle are calculated

Figure 10

Figure 11

(1) during a low speed
(2) during a high speed

Figure 13

(3) gain
(4) (for right curve)
(5) displacement A

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Figure 8

(A)

(B)
(3) differentiated value

Figure 9

Figure 12

(1) correction width
(2) velocity V

Figure 15

(4) right curve with a large radius of curvature
(5) large
(6) right curve with a small radius of curvature
(7) large
(8) small
(9) small

Figure 17

(10) gain
(11) (for left curve)
(12) displacement A

Figure 16

(13) gain
(14) (for left curve)
(15) displacement A

Figure 14

(16) gain
(17) (for right curve)
(18) displacement A

Figure 18

Figure 19

70 cut line
72 cut line

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Figure 20

Figure 21

VERIFICATION OF A TRANSLATION

I, the below named translator, hereby declare that:
My name and post office address are as stated below:

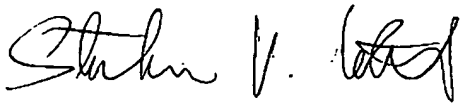
Stephen V. Vitek, 1204 False Creek Way, Chesapeake, VA 23322

That I am knowledgeable in the English language and in the language in which the below identified international document was written, and that I believe the English translation of the attached document:
Japanese Unexamined Patent Application No. 6-267304 "HEADLIGHT DEVICE FOR VEHICLES", patent applicant Toyota Motor Corporation,
is a true and complete translation of the above identified document.

I hereby declare that all statements made herein are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the document.

Date: October 14, 2005
Stephen V. Vitek

Full name of translator



Signature of translator